A Validation Study of the Converged Design CF Rainsuit

Ghee W. Ho

Walter R. Dyck

Defence R&D Canada – Toronto

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Author

Ghee W. Ho and Walter R. Dyck

Approved by

Keith Hendy

Head, Human Factors Research and Engineering Section

Approved for release by

K.M. Sutton

Chair, Document Review and Library Committee

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Abstract

Directorate of Land Requirements (DLR), and the Directorate of Air Requirements (DAR), within the Department of National Defence have mutually consented on a co nverged Canadian Forces (CF) rain suit design. In order to better understand the impact of these shared design features and rain suit fabric on Land Force (LF) operations, DLR has expressed a requirement to assess the acceptability of the new rain suit. Defence Research and Development Canada Toronto (DRDC Toronto), and the Land Force Trials and Evaluation Unit (LFTEU) were jointly tasked to design and carry out a field trial to validate the converged design.

A questionnaire developed using the Repertory Grid technique, was administered to twenty-four non-commissioned members of the CF, who were instructed to wear two of the four different versions of the proposed converged rain suits alternately during their normal duties throughout a period of two months. Analysis of data acquired through questionnaires and focus groups at the conclusion of the trial period, showed that the overall design feature specification is acceptable to put into service as it stands.

Résumé

La Direction - Besoins en ressources terrestres (DBRT) et la Direction – Besoins en ressources aériennes (DBRA) du ministère de la Défense nationale se sont entendues sur un modèle convergent d'imperméable pour les Forces canadiennes. Pour mieux comprendre les répercussions de l'adoption de modèles d'imperméables comportant des caractéristiques et du tissu communs sur les activités de la Force terrestre (FT), la DBRT a exprimé le besoin d'évaluer l'acceptabilité du nouvel imperméable. Recherche et développement pour la Défense Canada – Toronto (RDDC Toronto) et l'Unité d'essai et d'évaluation de la Force terrestre (UEEFT) ont été mandatés pour élaborer et effectuer un essai de validation sur le terrain du modèle convergent.

Un questionnaire élaboré à l'aide de la grille de Kelly a été remis à vingt-quatre militaires du rang des Forces canadiennes à qui on a demandé de porter tour à tour deux des quatre modèles différents d'imperméable pendant l'exécution de leurs tâches courantes sur une période de deux mois. À la fin de la période d'essai, les données recueillies grâce au questionnaire et à des groupes de consultation ont été analysées et ont révélé que les caractéristiques de conception d'ensemble sont acceptables et que les vêtements peuvent être mis en service sans modifications.

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Executive summary

The Directorate of Air Requirements (DAR) and the Directorate of Land Requirements (DLR) have independently developed their version of the next generation in-service rain suit for the Air Force (AF) and Land Force (LF),respectively. In order to streamline cost and production, Canadian Forces (CF) headquarter directed DAR, DLR, Directorate of Soldier Systems Program Management (DSSPM), and the Canadian industries to jointly develop and specify design features for a next generation in-service (or converged) CF rain suit, which will be suitable for both CF AF and LF members. The first task facing the converged CF rain suit design team was to compare essential and desirable design features that the new suit would incorporate. Some of these specific design features, however, were not examined by DLR in the previous LF rain suit development trial. In order to better understand the impact of these shared design features and rain suit fabric have on LF operations, DLR tasked the Land Force Trials and Evaluation Unit (LFTEU) and DRDC Toronto to conduct a validation and confirmatory study, from 19th April until 14th June, 2004, to evaluate the design features and fabric of the converged CF rain suit, and determine its suitability for LF operations.

Twenty-four non-commissioned members of the CF LF from 1 Royal Canadian Regiment (RCR), Petawawa, were instructed to wear two of the four different versions of the proposed converged rain suits alternately during their normal duties throughout the trial period. Analysis of data acquired through questionnaires and focus groups at the conclusion of the trial period, showed that the converged design features are significantly superior to those found in the current in-service rain suit. Furthermore, the participants felt that the Gortex™ fabric in the converged rain suit is less air permeable, and more restrictive in term of allowing for ample airflow inside the garment, whereas, no such issues were being raised in the Stedair™ converged rain suit. The overall design of the converged rain suit could still use some minor improvements, but is acceptable to be put into service as it stands, and is recommended for operational use at this time.

Sommaire

La Direction – Besoins en ressources aériennes (DBRA) et la Direction - Besoins en ressources terrestres (DBRT) ont mis au point indépendamment une version de la prochaine génération de l'imperméable réglementaire pour la force aérienne (FA) et la force terrestre (FT), respectivement. Dans le but de rationaliser les coûts et la confection, le quartier général des Forces canadiennes (FC) a demandé à la Direction – Besoins en ressources aériennes (DBRA), à la Direction - Besoins en ressources terrestres (DBRT), à la Direction de l'administration du programme de l'équipement du soldat (DAPES) et à l'industrie canadienne de travailler de concert à l'élaboration et à la détermination de caractéristiques conceptuelles pour une nouvelle génération d'imperméables réglementaires (ou convergents) des FC qui pourraient convenir aux membres de la FA et de la FT des FC. La première tâche confiée à l'équipe de conception de l'imperméable convergent des FC était de comparer les caractéristiques de conception essentielles et souhaitables que le nouvel imperméable devait incorporer. Certaines de ces caractéristiques, cependant, n'avaient pas été examinées par la DBRT au cours des travaux précédents de développement d'un imperméable pour la FT. Pour mieux comprendre les répercussions qu'auront les caractéristiques de conception et le tissu communs sur les activités de la FT, la DBRT a chargé l'UEEFT et DRDC Toronto d'effectuer une étude de validation et de confirmation entre le 19 avril et le 14 juin 2004 pour évaluer les caractéristiques de conception et le tissu de l'imperméable convergent de la FC et d'établir s'il convenait aux activités de la FT.

Vingt-quatre militaires du rang de la FT du 1er bataillon du Royal Canadian Regiment ont reçu la consigne de porter tour à tour deux des quatre versions de l'imperméable convergent proposé pendant toute la période d'essai. L'analyse des données recueillies grâce au questionnaire et à des groupes de consultation à la fin des essais a démontré que les caractéristiques de conception convergentes sont considérablement supérieures à celles de l'imperméable réglementaire actuel. De plus, les participants ont jugé que le tissu Gortex[MC] est moins perméable à l'air et constitue une meilleure barrière à la circulation d'air à l'intérieur du vêtement, alors que rien de tel n'a été signalé en ce qui concerne l'imperméable en Stedair[MC]. La conception d'ensemble de l'imperméable convergent pourrait quand même faire l'objet d'améliorations mineures, mais il peut être mis en service tel quel et on le recommande pour une utilisation opérationnelle dès maintenant.

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Introduction

The Directorate of Land Requirements (DLR) within the Department of National Defence has identified the current Canadian Forces Land Force (CF LF) rain suit, as a garment in need of improvement, and has initiated a project to develop a new rain suit which will better meet the needs of the LF in a more modern environment.

On April, 2002, the Land Force Trials and Evaluation Unit (LFTEU) and Defence Research and Development Canada – Toronto (DRDC Toronto) were tasked by DLR to conduct an 8-month long rain suit study, with soldiers from Whiskey Battery artillery school at CFB Gagetown. In that trial, the participants compared and evaluated two rain suits that were made with two different fabrics: a breathable, moisture vapour permeable fabric, and a rubber-like fabric. Both rain suits were printed in the CAnadian Disruptive PATtern (CADPAT) fabric, and had similar design features. Trial results showed that the soldiers preferred the rain suit made of the breathable fabric, and deemed it more superior to the one made of the rubber-like fabric. Moreover, the soldiers also identified (rank ordered) and confirmed a list of desirable and functional rain suit design features the suits should possess. Supported by Human Factors and scientific research, DLR accepted the specifications recommended in the development of the next generation in-service CF LF rain suit.

Concurrent to that activity, the Directorate of Air Requirements (DAR) introduced a new Canadian Forces Air Force (CF AF) rain suit, also constructed with a breathable CADPAT fabric, but with several design features that were different from those specified for the new CF LF rain suit.

As a result of a CF headquarter directive, DLR, DAR, Directorate of Soldier Systems Program Management (DSSPM), and the Canadian industries entered into a joint development to converge the LF and AF rain suit designs. The first task facing the converged CF rain suit design team was to compare essential and desirable design features that the new suit would incorporate. Some of these specific design features, however, were not examined by DLR in the previous trial. Therefore, DLR once again tasked LFTEU and DRDC Toronto to conduct a confirmatory study, from 19th April until 14th June, 2004, to evaluate the design features and fabric of the converged CF rain suit, and determine its suitability for LF operations.

Trial Objectives

The objectives of this study were:

1. Using carefully designed questionnaires, rating scales, and scaling techniques, to objectively evaluate which rain suit variant is judged to be superior in relation to the combined list of performance criteria, including material issues.

2. To examine the effect (if any) of the new Clothe The Soldier (CTS) fragmentation protective vest (FPV), and tactical vest (TV) , when being worn together with the converged design CF rain suit.

3. Recommend changes (if any) to the design features, in order to better address the needs of CF LF soldiers.

The Converged Design CF Rain Suit and its variants

The converged design rain suits can be described as a two-piece garment, namely a jacket and pants combination. The jacket is about ¾ length, with vents on the back, chest, and under the arms. The flaps on the back and chest vents are lined with foldable/hidden reflective tape tabs. There are long underarm zippers that extend towards the elbow. The jacket also has a detachable hood, which can be adjusted to provide head protection as required.

Other features being considered in the converged CF rain jacket design, include: a beaver tail, a bottom hem and waist elastic draw string; a loop and tab feature to secure the jacket between the legs in order to prevent billowing; a waterproof front zipper system protected by a double flap with snaps; a reinforced patch (cordura) over the elbows; breast pockets with Velcro openings and mesh on the inside of the jacket; large bellow type side pockets; waterproof zippered chest pass-through; Lycra-spandex cuffs with modified adjustable Velcro closure; and an internal mesh across the back with nylon lining along the sleeves.

The rain pants have an improved elasticized waistband with an additional drawstring to improve fit and aid adjustment. It also has pockets with double snap and waterproof zippered openings, zippered pass through, as well as zippered cuffs with elastic bands and Velcro closures and adjustments.

The manufacturer agreed to provide two types of rain suits made from the Stedair™ fabric that was deemed superior in the previous CF rain suit trial (Ho and Dyck, 2003). Both jackets were to have long underarm zippers, but only one will be fitted with an inner lining (along the sleeves and across the back). The manufacturer was to provide approximately 48 rain suits with lining, and another 48 without the lining. However, of the rain suits delivered, only half were Stedair™ rain suits, the rest were made of Gortex™ (which like Stedair™ is another anti-static, waterproof, and moisture vapour permeable laminated nylon fabric). Only some of the jackets came fitted with the long underarm zippers, the rest were fitted with a shorter version of the zippers. Moreover, the majority of the rain jackets came fitted with a lining. The trial team from DLR, LFTEU and DRDC Toronto decided to cut out the lining in some of the rain jackets, to better examine the effect of lining versus no lining on the performance of the converged design rain suits, and to determine whether the converged design features are suitable for fielding by the LF. Table 1 summarizes the various types of rain suits used in the trial.

Table 1: The different types of rain suit.

Group	*Variant*	*Fabric*	*Underarm Zippers*	*Inner Lining*	*Number of Participants who filled out the Exit Questionnaire*
I	A	Stedair™	Long	With and without	5
II	B	Stedair™	Short	With and without	6
III	C	Gortex™	Long	With and without	9
IV	D	Gortex™	Short	With and without	4

Methods

Subjects

Twenty-four non-commissioned members from the B Company, 1st Royal Canadian Regiment, CFB Petawawa, were randomly assigned to one of the four groups, as shown in table 1. All the participants from each group were issued two rain jackets and a rain pants of the best possible fit. The two jackets were made from the fabric type assigned to each group (see Table 1), but one with lining and the other without. Participants were instructed to wear their two rain suits, as much as possible, during their normal duties throughout the period from 19th April, until 14th June, 2004. They were also told to wear their 2 rain suits alternately, on days when a rain suit would normally be worn. Moreover, the participants were not told about the different fabrics used in this trial.

However, due to the limitation imposed by the small number of rain suits made available for each size and variant, it was difficult to find suitable participants for each group conditions. Furthermore, some participants were not able to attend the end-of-trial questionnaire and focus group sessions. As a result, the final number of participants in each group condition, i.e., the group sample sizes, were at best small and unequal (see Table 1).

Experimental Design

Small and unequal sample sizes are often hindrances to reliable statistical inferences. In order to cope with the small and unequal group sizes presented in this trial, participants from various groups (see Table 1) were combined to form experimental categories, according to the rain suit fabric. As shown in Table 2, Experimental Category 1 consists of participants from Groups I and II, who were issued the Stedair™ rain suits, whereas, Experimental Category 2 consists of participants from Groups III and IV, who were given the Gortex™ rain suits. By combining the groups in this manner, the sample size is now larger, so that the effects (if any) of lining versus no lining, and fabric types can now be statistically examined with increased confidence.

Table 2: Proposed Repeated Measures Experimental Design.

Experimental Category	Sample Size	Fabric	Lining
1 - Group I (n=5) & Group II (n=6)	N=11	Stedair™	With & Without
2 - Group III (n=9) & Group IV (n=4)	N=13	Gortex™	With & Without

This process of combining participant groups into experimental categories, essentially negates the distinction between long and short underarm zippers. However, this is justifiable, since there is supposed to be only one standard length for the underarm zippers. It was not the intent of this trial to examine the effectiveness of underarm zippers with different lengths, and how they affect the performance of the rain suits. Furthermore, the participants and trial staff felt that the length difference between the two zippers was too small to have any effect on how the rain suits would perform. Therefore, it is reasonable to assume that any effects imposed by the difference in length between the long and short underarm zippers are negligible, and thus have no effect on the participants' responses.

Data Analysis Strategy

The non-parametric repeated measures Wilcoxon signed-ranks test was used to evaluate the difference in performance and suitability between the two rain suits, since this study dealt with repeatedly measured ordinal ratings.

This procedure tests whether the difference scores (between the rain suits for each criterion) are systematically positive (or negative), and whether this difference is statistically significant (i.e., $p<0.05$). In other words, this statistical technique will determine whether one rain suit is significantly (statistically speaking), and consistently superior (or inferior) than the other.

Questionnaire and Focus Group

To elicit feedback from the participants, a two-part questionnaire was administered at the conclusion of the trial before the focus group session. The questionnaire essentially probed into specific areas of performance of the rain jacket and pants, including:

- Specific design features and fit issues;
- Assessment of the whole item, regarding activities, suitability for various weather conditions, and compatibility with other field kit items; and,
- Overall ratings.

In part one of the questionnaire, the participants were required to use a 9 point acceptability scale to rate their two assigned rain suits against the in-service rain suit, across 35 criteria. These 35 criteria are based on constructs elicited from SMEs (subject matter experts) using the Repertory Grid technique, which is a non-biased interactive knowledge elicitation tool (Ho and Dyck, 2003).

In particular, the 35 items on this questionnaire (Annex A) probed into core areas of evaluation, which include:

- Protection from Elements.
- Moisture Management.
- Thermal Regulation.
- Adjustment & Fit.
- Appearance.
- Durability.
- Ease of Maintenance & Stowage.
- Compatibility.
- Functionality (does the job).
- Usability (ease of use).
- Comfort , and
- Serviceability (ready to put into service).

The second part of the questionnaire consisted of eight open ended questions, probing into various aspects of the rain suit performance, as well as the way in which the participants wore their rain suits.

In addition, a Semi-Structured Focus Group was also conducted after the questionnaire session. The questions used in the focus group were based on issues that were identified as problematic from the questionnaire, which were screened as preparation for the focus groups. The participants were also given ample opportunity to provide free responses on issues that they wanted to address.

Results and Discussions

The ratings data collected from the participants in experimental category 1 and 2 were analysed separately, and the empirical findings are as follows:

By examining data from Experimental Category 1, it was possible to test whether the presence or absence of the lining, had a significant effect on how the participants evaluate their Stedair™ and in-service rain suits. Similarly, by examining data from experimental category 2, one could to do the same for the Gortex™ rain suits.

The results of the non-parametric statistical analyses are summarized in Table 3.

Table 3: Results of the non-parametric Wilcoxon signed rank test.

	Number of items that had a significant difference ($p<0.05$)	***Number of items that DID NOT have a significant difference ($p<0.05$)***
Stedair™	2 items Lining is more superior to no lining.	32 items No difference between lining and no lining.
Gortex™	7 items No lining is more superior to lining.	27 items No difference between lining and no lining.

Stedair™ Rain Jacket

For the Stedair™ rain suit (i.e., Experimental Category 1), participants perceived that the rain jacket with lining was consistently and significantly ($p<0.05$) superior to the one with no lining, on the following 2 items:

- Item 1. Ability to keep me comfortably warm in cold rainy weather.

and

- Item 34. Overall serviceability of the rain jackets (ready to put into service).

And, of the remaining 32 items, the Wilcoxon signed rank test indicated that there were no significant differences ($p>0.05$) between the Stedair™ rain jacket with a lining and the one without a lining.

In general, the participants perceived that there was no meaningful difference between the two Stedair™ rain jackets (with and without the lining), however, they would still like to have the option of having a lining inside the rain jacket when the weather gets cold. That is why they indicated that the rain jackets with the lining was the one that they would prefer to see put into service.

Gortex™ Rain Jacket

As for the Gortex™ rain suit (i.e., Experimental Category 2), participants perceived the rain jacket with no lining to be significantly superior than the rain jacket with lining on the following 7 items:

- Item 2. Ability to keep me comfortably cool in hot rainy weather.
- Item 13. Dries quickly.
- Item 15. Effectiveness in keeping the rain out, while I wear my frag vest and webbing.
- Item 17. Effectiveness in regulating my body temperature, while I am carrying my rucksack on my back.
- Item 18. Ability for sufficient air to flow inside the rain jacket keeping me comfortable (underarm zippers closed).
- Item 19. Ability for sufficient air to flow inside the rain jacket keeping me comfortable (underarm zippers open).

and

- Item 23. Effectiveness in regulating my body temperature, while wearing my rain jacket, without frag vest, webbing or rucksack.

In relation to the Gortex™ jacket with no lining, participants seemed to feel that the Gortex™ rain jacket with lining was less able to regulate body temperature, and dried slowler, because the air-flow inside the jacket was more restricted. This was especially so when the weather was warm, as well as when the participants carried their rucksack, and/or wore their frag vest and webbing with the rain jacket.

This might be due to a relatively lower air permeability of the Gortex™ fabric, when compared to the Stedair™ fabric. This is not meant to directly compare the Gortex™ rain suits with those made of Stedair™, but merely meant as a possible explanation that having and not having a lining is more noticeable by the participants wearing the Gortex™ rain jackets.

Of the remaining 27 items, the Wilcoxon signed rank test indicated that there were no significant differences ($p>0.05$) between the Gortex™ rain jacket with lining and the one without. In other words, the participants perceived that there were no meaningful differences

between the two Gortex™ rain jackets, with and without the lining, when evaluated on most of the criteria.

Further, descriptive statistical analyses also indicated that all four variants of the on-trial rain jackets (Stedair™, Gortex™, with and without lining) were perceived as more superior to the in-service rain jacket. Except for the in-service rain jacket, all four on-trial variants of the converged design rain jackets were rated as acceptable or better (i.e., with a rating equal or greater than 6, since a rating of 5 denotes borderline acceptability) across eight 'overall' evaluation criteria, i.e., items 27 to 35. These eight 'overall' criteria are as follows:

- Item 27 Overall ability to remain cool in hot weather, and warm in cold weather (i.e., Overall ability to maintain thermal comfort).
- Item 28 Overall ability to keep the rain out.
- Item 29 Overall design features.
- Item 30 Overall comfort.
- Item 31 Overall usability (ease of use).
- Item 32 Overall functionality (does the job – keeps me protected from the elements).
- Item 33 Overall compatibility with other clothing and equipment.

and

- Item 34 Overall serviceability of the rain jacket (ready to put into service).

Tables 4a, and 4b summarize respectively, the percentage of the participants' acceptability ratings that are equal or greater than 6, and their mean acceptability ratings across the eight 'overall' evaluation criteria.

Table 4a: Percentage of acceptable ratings that are equal or greater than 6.

Items	*27*	*28*	*29*	*30*	*31*	*32*	*33*	*34*
In-service rain jacket	0 %	42%	8%	8%	29%	25%	17%	5.3%
Stedair™ (Lining)	91%	100%	100%	100%	100%	100%	100%	100%
Stedair™ (No Lining)	91%	100%	91%	91%	100%	100%	100%	91%
Gortex™ (Lining)	83%	100%	100%	100%	100%	100%	100%	100%
Gortex™ (No lining)	83%	100%	100%	100%	100%	100%	100%	100%

Table 4b: Means of overall acceptability ratings.

Items	*27*	*28*	*29*	*30*	*31*	*32*	*33*	*34*
In-service rain jacket	2.04	4.71	2.41	2.67	2.00	3.46	2.75	2.43
Stedair™ (Lining)	7.27	8.00	8.27	8.36	8.09	8.64	8.27	8.36
Stedair™ (No Lining)	7.18	8.00	8.18	8.00	8.09	8.36	8.36	7.54
Gortex™ (Lining)	7.08	8.23	8.23	8.31	7.85	8.17	8.00	8.46
Gortex™ (No lining)	7.25	8.23	8.23	8.31	8.08	8.33	8.25	8.31

As shown in Tables 4a & 4b, all (100%) of the overall acceptability ratings for the four rain jacket variants clearly exceeded the traditional '80% rule' requirements. As well, all mean ratings exceeded 7. Together, these results indicate that at least 80% of our participants felt that the overall design feature specifications of the converged design rain jacket is acceptable, and is ready to put into service as it stands.

Results presented in Tables 4a & 4b also revealed that the in-service rain jacket was inferior to all four variants of the converged design rain suits, and was deemed unacceptable across all the 'overall' evaluation criteria, thus confirming that the CF needs to replace this garment with the converged design rain suit.

Rain Pants

In Item 35 of the questionnaire, participants were asked to rate the performance of their In-service rain pants against those of the assigned rain pants. Table 5 showed that only 32% of the participants felt that the in-service rain pants were acceptable, whereas, 100% of the participants felt that the both converged designed rain pants were acceptable, irrespective of their fabric. Liners were absent in all the rain pants.

Table 5: Percentage of acceptable ratings that are equal or greater than 6, and the means of overall acceptability ratings.

Item 35	*%*	*Mean*
In-service rain jacket	32%	3.32
Stedair™ (No Lining)	100%	8.27
Gortex™ (No lining)	100%	8.14

Furthermore, all mean ratings exceeded 8. Together, these results indicate that at least 80% of participants felt that the converged design rain pants are both acceptable and superior to the in-service rain pants.

Additional information was revealed by analyzing the second part of the questionnaire, and are presented as follows:

- 100% of participants indicated that 'Yes, the back vent is long enough'.
- 91.7% did not experience any leakage through the underarm zippered vents.
- 83.3% would choose rain suit variant A (with lining) to be the convergence design to put into service.
- 79.2% found the converged rain suit jacket fit over frag vest to be acceptable.
- 79.2% said a lining is desirable.
- 91.7% said the position of underarm vent is optimal.
- 87% said the underarm vent length is functional.
- 58.3% wore rain jacket on top of frag vest.
- 33.3% wore rain jacket under frag vest.
- 8.3% wore rain jacket on top and under frag vest.
- 94.7% wore rain jacket under webbing.
- 5.3% wore rain jacket on top and under webbing.
- 64.7% preferred wearing jacket on top of frag vest.
- 35.3% preferred wearing jacket under frag vest.
- 18.2% preferred wearing jacket on top of webbing.
- 81.8% preferred wearing jacket under webbing.

Conclusion: A summary of findings substantiated by focus group feedback

This section summarizes the findings presented in the result section, and integrates them with the supportive feedback from the exit focus group. The focus group was conducted at the conclusion of the field trials in June, 2004.

All in all, the in-service rain suit was perceived as both inferior and unacceptable by all of our participants. The participants also felt that a liner would be useful during cold weather, but they would like to be able to promote better air flow by having the liner to be removable.

The participants were unable to distinguish meaningful differences of having and not having the lining, except with the Gortex™ rain suit. This might mean that the Gortex™ fabric is less air permeable, and more restrictive in term of allowing for ample airflow inside the garment.

Moreover, opinions were also offered on how to improve/modify some design features further. The list of modifications that the participants would like to see implemented, are:

- to consider incorporating a removable liner into the final design;.
- to attempt to reduce the bulkiness of the rain suit, by employing newer, lighter and less voluminous fabric;
- to attach a better grasp mechanism on zippers;
- to incorporate rain holes in the pockets to allow for proper drainage;
- to upgrade zippers; and,
- to include an attachment for name tags.

In conclusion, the converged design features are significantly superior to those found in the in-service rain suit. Most of the problems identified in Gortex™ rain suit are material/fabric related issues interacting with the inner liner, whereas no such issues were being raised in the Stedair™ rain suit. The overall design of the converged rain suit could still use some minor improvements, but is acceptable enough to be put into service as it stands, and is recommended for operational use at this time.

Reference

Ho, G. W., Dyck, W.R. (2003) Assessment of Improved Rain Suits. DRDC Technical Report TR 2003-116

Annex A

The 2-Part Questionnaire to assess the converged design rain suit.

Rain Jacket Evaluation Questionnaire Group ☐☐ Last 3 digits-SN ☐☐☐

Rate the acceptability of the current in-service (I-S) rain jacket, rain jacket A (with lining) and rain jacket B (without lining) in each criteria. When rating compare the 3 rain jackets to each other:

1	2	3	4	5	6	7	8	9
Completely Unacceptable				Borderline				Completely Acceptable

1. Ability to keep me comfortably warm in cold rainy weather.								
I-S ○	○	○	○	○	○	○	○	○
A ○	○	○	○	○	○	○	○	○
B ○	○	○	○	○	○	○	○	○
Comments:								
2. Ability to keep me comfortably cool in hot rainy weather.								
I-S ○	○	○	○	○	○	○	○	○
A ○	○	○	○	○	○	○	○	○
B ○	○	○	○	○	○	○	○	○
Comments:								
3. Ease of packing.								
I-S ○	○	○	○	○	○	○	○	○
A ○	○	○	○	○	○	○	○	○
B ○	○	○	○	○	○	○	○	○
Comments:								
4. Ease of adjusting to fit my body.								
I-S ○	○	○	○	○	○	○	○	○
A ○	○	○	○	○	○	○	○	○
B ○	○	○	○	○	○	○	○	○
Comments:								
5. Weight.								
I-S ○	○	○	○	○	○	○	○	○
A ○	○	○	○	○	○	○	○	○
B ○	○	○	○	○	○	○	○	○
Comments:								

Rate the acceptability of the current in-service (I-S) rain jacket, rain jacket A (with lining) and rain jacket B (no lining) in each criteria. When rating compare the 3 rain jackets to each other:

1	2	3	4	5	6	7	8	9
Completely Unacceptable				Borderline				Completely Acceptable

6. Ability to block wind.								
I-S ○	○	○	○	○	○	○	○	○
A ○	○	○	○	○	○	○	○	○
B ○	○	○	○	○	○	○	○	○
Comments:								

7. Allows drying of underlying combat clothing (if it got wet for any reason, while still wearing the rain jacket).								
I-S ○	○	○	○	○	○	○	○	○
A ○	○	○	○	○	○	○	○	○
B ○	○	○	○	○	○	○	○	○
Comments:								

8. Ability to endure rough usage.								
I-S ○	○	○	○	○	○	○	○	○
A ○	○	○	○	○	○	○	○	○
B ○	○	○	○	○	○	○	○	○
Comments:								

9. Ease of maintenance.								
I-S ○	○	○	○	○	○	○	○	○
A ○	○	○	○	○	○	○	○	○
B ○	○	○	○	○	○	○	○	○
Comments:								

10. Ability to not interfere with weapon operation.								
I-S ○	○	○	○	○	○	○	○	○
A ○	○	○	○	○	○	○	○	○
B ○	○	○	○	○	○	○	○	○
Comments:								

Rate the acceptability of the current in-service (I-S) rain jacket, rain jacket A (with lining) and rain jacket B (no lining) in each criteria. When rating compare the 3 rain jackets to each other:

1	2	3	4	5	6	7	8	9
Completely Unacceptable				Borderline				Completely Acceptable

11. Compatibility with combats.								
I-S ○	○	○	○	○	○	○	○	○
A ○	○	○	○	○	○	○	○	○
B ○	○	○	○	○	○	○	○	○
Comments:								
12. Ability to move (not feeling restricted) when soaked.								
I-S ○	○	○	○	○	○	○	○	○
A ○	○	○	○	○	○	○	○	○
B ○	○	○	○	○	○	○	○	○
Comments:								
13. Dries quickly.								
I-S ○	○	○	○	○	○	○	○	○
A ○	○	○	○	○	○	○	○	○
B ○	○	○	○	○	○	○	○	○
Comments:								
14. Effectiveness in keeping the rain out, while I wear my frag vest and webbing.								
I-S ○	○	○	○	○	○	○	○	○
A ○	○	○	○	○	○	○	○	○
B ○	○	○	○	○	○	○	○	○
Comments:								
15. Effectiveness in regulating my body temperature, while I wear my frag vest and webbing.								
I-S ○	○	○	○	○	○	○	○	○
A ○	○	○	○	○	○	○	○	○
B ○	○	○	○	○	○	○	○	○
Comments:								

Rate the acceptability of the current in-service (I-S) rain jacket, rain jacket A (with lining) and rain jacket B (no lining) in each criteria. When rating compare the 3 rain jackets to each other:

1	2	3	4	5	6	7	8	9
Completely Unacceptable				Borderline				Completely Acceptable

16. Effectiveness in keeping the rain out, while I am carrying my rucksack on my back.								
I-S ○	○	○	○	○	○	○	○	○
A ○	○	○	○	○	○	○	○	○
B ○	○	○	○	○	○	○	○	○
Comments:								

17. Effectiveness in regulating my body temperature, while I am carrying my rucksack on my back.								
I-S ○	○	○	○	○	○	○	○	○
A ○	○	○	○	○	○	○	○	○
B ○	○	○	○	○	○	○	○	○
Comments:								

18. Ability for sufficient air to flow inside the rain jacket keeping me comfortable (underarm zippers closed).								
I-S ○	○	○	○	○	○	○	○	○
A ○	○	○	○	○	○	○	○	○
B ○	○	○	○	○	○	○	○	○
Comments:								

19. Ability for sufficient air to flow inside the rain jacket keeping me comfortable (underarm zippers open).								
I-S ○	○	○	○	○	○	○	○	○
A ○	○	○	○	○	○	○	○	○
B ○	○	○	○	○	○	○	○	○
Comments:								

20. Ability not to feel sticky and damp (clammy).								
I-S ○	○	○	○	○	○	○	○	○
A ○	○	○	○	○	○	○	○	○
B ○	○	○	○	○	○	○	○	○
Comments:								

Rate the acceptability of the current in-service (I-S) rain jacket, rain jacket A (with lining) and rain jacket B (no lining) in each criteria. When rating compare the 3 rain jackets to each other:

1	2	3	4	5	6	7	8	9
Completely Unacceptable				Borderline				Completely Acceptable

21. Tendency not to retain odour from sweat and dirt.								
I-S ○	○	○	○	○	○	○	○	○
A ○	○	○	○	○	○	○	○	○
B ○	○	○	○	○	○	○	○	○
Comments:								

22. Effectiveness in keeping the rain out, while wearing my rain jacket, without frag vest, webbing or rucksack.								
I-S ○	○	○	○	○	○	○	○	○
A ○	○	○	○	○	○	○	○	○
B ○	○	○	○	○	○	○	○	○
Comments:								

23. Effectiveness in regulating my body temperature, while wearing my rain jacket, without frag vest, webbing or rucksack.								
I-S ○	○	○	○	○	○	○	○	○
A ○	○	○	○	○	○	○	○	○
B ○	○	○	○	○	○	○	○	○
Comments:								

24. Water leakage through the back vents.								
I-S ○	○	○	○	○	○	○	○	○
A ○	○	○	○	○	○	○	○	○
B ○	○	○	○	○	○	○	○	○
Comments:								

25. Water leakage through underarm vents.								
I-S ○	○	○	○	○	○	○	○	○
A ○	○	○	○	○	○	○	○	○
B ○	○	○	○	○	○	○	○	○
Comments:								

Rate the acceptability of the current in-service (I-S) rain jacket, rain jacket A (with lining) and rain jacket B (no lining) in each criteria. When rating compare the 3 rain jackets to each other:

1	2	3	4	5	6	7	8	9
Completely Unacceptable				Borderline				Completely Acceptable

26. Ease of donning and doffing.								
I-S ○	○	○	○	○	○	○	○	○
A ○	○	○	○	○	○	○	○	○
B ○	○	○	○	○	○	○	○	○
Comments:								

27. Overall ability to remain cool in hot weather, and warm in cold weather (i.e., Overall ability to maintain thermal comfort).								
I-S ○	○	○	○	○	○	○	○	○
A ○	○	○	○	○	○	○	○	○
B ○	○	○	○	○	○	○	○	○
Comments:								

28. Overall ability to keep the rain out.								
I-S ○	○	○	○	○	○	○	○	○
A ○	○	○	○	○	○	○	○	○
B ○	○	○	○	○	○	○	○	○
Comments:								

29. Overall design features.								
I-S ○	○	○	○	○	○	○	○	○
A ○	○	○	○	○	○	○	○	○
B ○	○	○	○	○	○	○	○	○
Comments:								

30. Overall comfort.								
I-S ○	○	○	○	○	○	○	○	○
A ○	○	○	○	○	○	○	○	○
B ○	○	○	○	○	○	○	○	○
Comments:								

Rate the acceptability of the current in-service (I-S) rain jacket, rain jacket A (with lining) and rain jacket B (no lining) in each criteria. When rating compare the 3 rain jackets to each other:

1	2	3	4	5	6	7	8	9
Completely Unacceptable				Borderline				Completely Acceptable

31. Overall usability (ease of use).								
I-S ○	○	○	○	○	○	○	○	○
A ○	○	○	○	○	○	○	○	○
B ○	○	○	○	○	○	○	○	○
Comments:								
32. Overall functionality (does the job – keeps me protected from the elements).								
I-S ○	○	○	○	○	○	○	○	○
A ○	○	○	○	○	○	○	○	○
B ○	○	○	○	○	○	○	○	○
Comments:								
33. Overall compatibility with other clothing and equipment.								
I-S ○	○	○	○	○	○	○	○	○
A ○	○	○	○	○	○	○	○	○
B ○	○	○	○	○	○	○	○	○
Comments:								
34. Overall serviceability of the rain jacket (ready to put into service).								
I-S ○	○	○	○	○	○	○	○	○
A ○	○	○	○	○	○	○	○	○
B ○	○	○	○	○	○	○	○	○
Comments:								
35. Overall performance of the rain pants.								
I-S ○	○	○	○	○	○	○	○	○
A/B ○	○	○	○	○	○	○	○	○
Comments:								

Additional Questions

For each of the following questions, circle your answer choice clearly, and comment.

1. Are the back vents' flaps long enough to keep the water and/or wind out? Yes / No
Comments:

2. Do you experience any leakage from the underarm zippered vents? Yes / No
Comments:

3. Which rain jacket will you choose to be the best converged design? Rain Jacket A / Rain Jacket B
Comments:

4. Is the fit of the rain jacket over the top of the fragmentation vest acceptable? Yes / No
Comments:

5. Is the black and green nylon lining a desirable feature in a rain jacket? Why? Yes / No
Comments:

6. Is the position of the underarm vents optimal? Yes / No
Comments:

7. Are the underarm vents long enough to be functional? Yes / No
Comments:

8a. I wore my rain jacket on top of / under my fragmentation vest.

8b. I wore my rain jacket on top of / under my webbing.

8c. I prefer to wear my rain jacket on top of / under my fragmentation vest.

8d. I prefer to wear my rain jacket on top of / under my webbing.
Comments:

End of questionnaire